NIVELCO

# EasyTREK

## SP-300, SP-300 Ex

## two-wire compact ultrasonic level transmitter

Installation and Programming manual

6th edition

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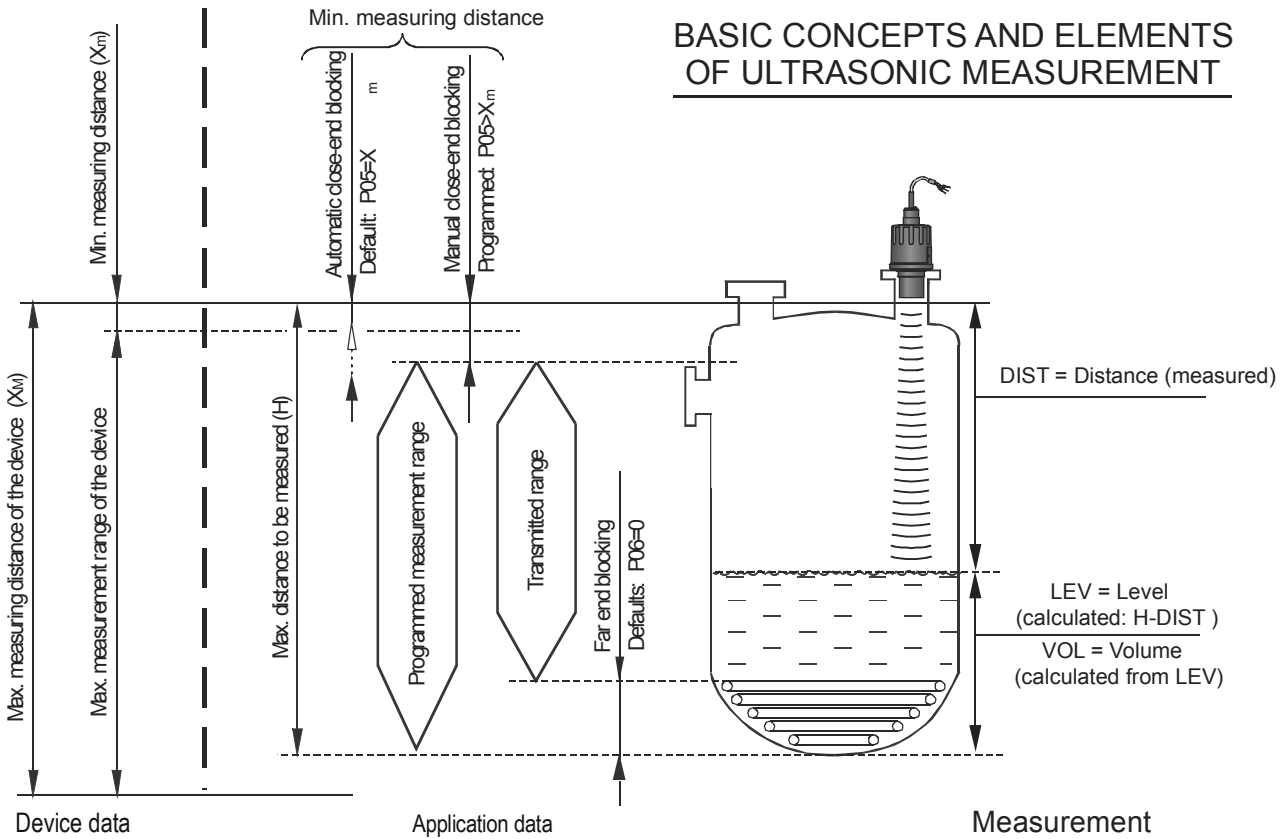
# BASIC CONCEPTS AND ELEMENTS OF ULTRASONIC MEASUREMENT



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*Thank you for choosing a NIVELCO instrument.*
*We are sure that you will be satisfied throughout its use.*

# 1. INTRODUCTION

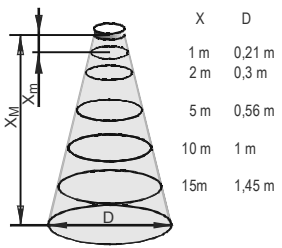
**Application**

The EasyTREK compact ultrasonic level transmitters from NIVELCO are excellent tools for level measurement of liquids.
Level measurement technology based on the non-contacting ultrasonic principle is especially suited for applications where, for any reason, no physical contact can be established to the surface of the material to be measured.

**Principle of Operation**

The ultrasonic level metering technology is based on the principle of measuring the time required for the ultrasound pulses to make a round trip from the sensor to the level to be measured and back. The sensor emits an ultrasonic pulse train and receives the echoes reflected. The intelligent electronic device processes the received signal by selecting the echo reflected by the surface and calculates from the time of flight the distance between the sensor and the surface which constitutes the basis of all output signals of the EasyTREK.

**A Total beam angle** of 5°-7° at –3 dB as is featured by most of Nivelco's SenSonic transducers ensuring a reliable measurement in narrow silos with uneven side walls as well as in process tanks with various protruding objects. Furthermore, as a result of the narrow beam angle - the emitted ultrasonic signals have an outstanding focusing - deep penetration through gases, vapour and foam is ensured.




Diameters corresponding to
5° beam angle.

**Minimum measuring distance ($X_m$)** is determined by the design of the unit within which the measurement is not possible (Dead Zone) its value is according with **P05** on page 18. Since measurement is impossible within this range material should not get into this zone.

**Maximum measuring distance ($X_M$)** is the greatest distance (determined by the design of the unit) which can be measured by the unit under ideal conditions. (See parameter **P04** on page 17). Maximum measuring distance of the actual application (H) must not be greater than $X_M$.

# 2. TECHNICAL DATA

## 2.1 GENERAL DATA

| | | |
|---|---|---|
| Transducer/enclosure materials | Polypropylene (PP),PVDF, PTFE/PP | |
| Process temperature | PP, PVDF and PTFE transducers -30°C…+90° | |
| Ambient temperature | -30 °C … +80 °C | |
| Pressure(1) (Absolute) | 0.05 … 0.3 MPa (0.5 … 3 bar) SS316Ti for sensors with stainless steel 0.09 ... 0.11 MPa (0.9 ... 1.1 bar) | |
| Seals | PP transducer: EPDM; All other transducer versions: FPM | |
| Ingress protection | IP 68 | |
| Power supply | 12(3) … 36 V DC with HART communication | 48 mW … 720 mW, Galvanic isolation; protection against surge transients |
| Accuracy(2) | ± (0.2% of the measured distance plus 0.05% of the range) | |
| Resolution | Depending on the measured distance: < 2 m: 1 mm, 2 ... 5 m: 2 mm, 5 ... 10 m: 5 mm, > 10 m: 10 mm | |
| Outputs | Analogue: 4 … 20 mA, (3.9 … 20.5 mA), $R_{tmax}$ = ($U_t$ – 11.4 V) / 0.02 A, Galvanic isolation; protection against surge transients | |
| | SPDT relay, 30 V / 1 A DC; 48 V / 0.5 A AC | |
| | Serial communication: HART interface (terminal resistor 250 Ohm) | |
| Electrical connection | 6 x 0.5 mm² shielded cable ∅6mm x 5m (available max. length 30m) | |
| Electrical protection | Class III SELV | |

(1) *For pressures below 1 bar representative of Nivelco should be consulted.*

(2) *Under optimal circumstances of reflection and stabilised transducer temperature.*

(3) *Only partial operation is provided. Realible operation without any restrictions is guaranteed at >13.4V terminal voltage.*

## 2.2 ADDITIONAL DATA FOR EX CERTIFIED DEVICES

| | |
|---|---|
| Ex marking | ⟨Ex⟩ II1G EEx ia IIB T6 IP68 |
| Intrinsically safety data | Ci ≤ 15 nF, Li ≤ 200 $\mu$H, Ui ≤ 30 V, Ii ≤ 140 mA, Pi ≤ 1 W **Ex-device should be powered by EEx ia power supply** |
| Ex power supply, loading | Uo < 30 V, Io < 140 mA, Po < 1 W, Voltage range 12 V … 30 V, $R_{t\ max}$ = ($U_t$ – 12 V) / 0.02 A |
| Medium temperature | For PP transducer –20 °C ... +70 °C, for PVDF transducer –20 °C ... +80 °C, for PTFE transducer –30 °C ... +90 °C |
| Ambient temperature | -20 °C … +70 °C |

## 2.3 SPECIAL DATA

**SPECIAL DATA FOR PP, PVDF AND PTFE TRANSDUCERS** (ALSO APPLIES TO EX MODELS)

| Type | SP□-39□ -□ | | SP□-38□-□ | | SP□-37□-□ | | SP□-36□-□ | SP□-34□-□ |
|---|---|---|---|---|---|---|---|---|
| Transducer material | PP, PVDF | PTFE | PP, PVDF | PTFE | PP, PVDF | PTFE | PP or PVDF | PP or PVDF |
| Max measuring distance * ($X_M$) [m / ft] | 4/13 | 3/10 | 6/20 | 5/16 | 8/26 | 6/20 | 10/33 | 15/49 |
| Min. measuring distance* (Dead band) [m / ft] | 0.2/0.65 | 0.25//0.82 | 0.25//0.82 | 0.25//0.82 | 0.35/1.2 | 0.35/1.2 | 0.35/1.2 | 0.45/1.5 |
| Total beam angle (-3dB) | 6° | | 5° | | 7° | | 5° | 5° |
| Measurement frequency | 80 kHz | | 80 kHz | | 50 kHz | | 60 kHz | 40 kHz |
| Process connection | 1" BSP and 1 ½" BSP/NPT | | 1" BSP and 2" BSP/NPT | | 1" BSP and 2" BSP/NPT | | 1" BSP | 1" BSP |

* (from the transducer face)

## 2.4 ACCESSORIES

- Certificate of Warranty
- Installation and Programming Manual
- Declaration of Conformity

## 2.5 ORDER CODES (NOT ALL COMBINATIONS ARE AVAILABLE)

**EasyTREK S P □ – 3 □ □ – □**

| HOUSING MATERIAL | CODE |
|---|---|
| PP | **A** |
| PVDF | **B** |
| PTFE / PP | **T** |

| RANGE M/FEET | CODE |
|---|---|
| 15/49 | **4** |
| 10/33 | **6** |
| 6/20 ; 8/26 * | **7** |
| 5/16 ; 6/20 * | **8** |
| 3/10 ; 4/13 * | **9** |

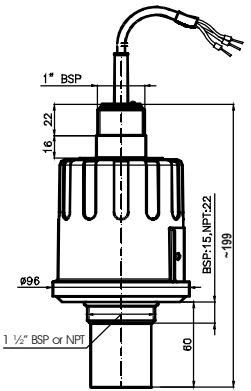
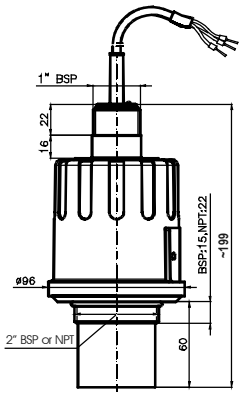
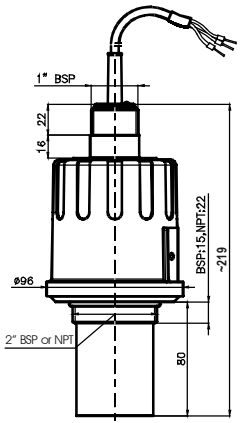
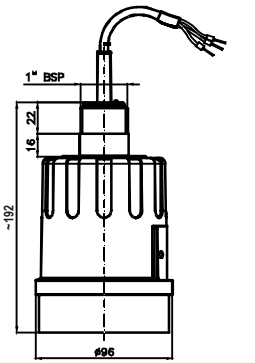
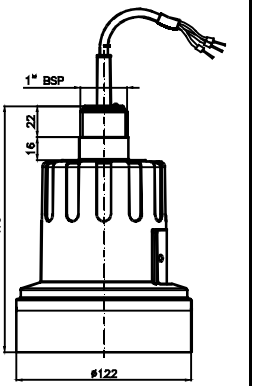
| PROCESS CONNECTION | CODE |
|---|---|
| 1"; 2" BSP thread | **0** |
| 2" NPT thread | **N** |
| 1" BSP quick conn. / PP | **F** |
| Bracket 200 mm | **K** |
| Bracket 500 mm | **L** |
| Bracket 700 mm | **M** |

| OUTPUT / EX | CODE |
|---|---|
| 4 … 20 mA / HART / LOGGER | **3** |
| 4 … 20 mA / HART | **4** |
| 4 … 20 mA / HART / LOGGER / Ex | **7** |
| 4 … 20 mA / HART / Ex | **8** |
| 4…20mA / Relay / HART | **H** |
| 4…20mA / Relay / HART / LOGGER | **A** |

The order code of an Ex version should end in '**Ex**'

* Measuring range depends on the material of the transducer

## 2.6 DIMENSIONS

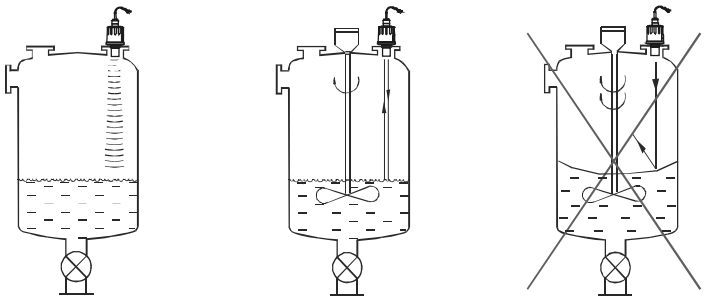
| EasyTREK SP□-39□-□ / PP, PVDF, PTFE | EasyTREK SP□-38□-□ / PP, PVDF, PTFE | EasyTREK SP□-37□-□ / PP, PVDF, PTFE | EasyTREK SP□-36□-□/ PP, PVDF | EasyTREK SP□-34□-□/ PP, PVDF |
|---|---|---|---|---|
|  |  |  |  |  |

# 3. INSTALLATION

## 3.1 LIQUID LEVEL MEASUREMENT

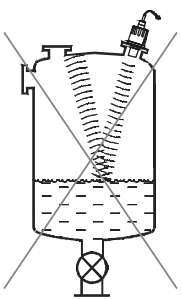
POSITION

The ideal position of the EasyTREK is on the radius
r = (0.3 … 0.5) R of the (cylindrical) tank / silo.
(Take also sonic cone on page 5 into consideration.)



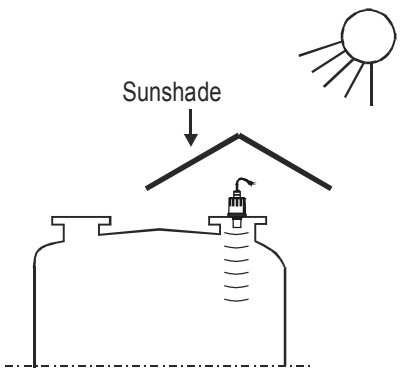
SENSOR ALIGNMENT

The sensor face has to be parallel to the surface of the liquid within ± 2-3°.



TEMPERATURE

Make sure that the transmitter is protected against overheating by direct sunshine.



**OBSTACLES**

Make sure that no objects (cooling pipes, bracing members, thermometers etc.) protrude into the sensing cone of the ultrasonic beam.

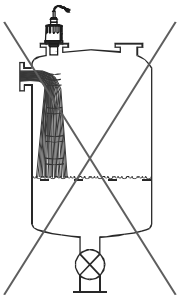
***Remark:*** *EasyTREK programming allows one fixed object that would otherwise disturb the measurement to be blocked out. (see* ***P29*** *of programming).*

**FOAM**

Foaming of the liquid surface may render ultrasonic level metering impossible. If possible, a location should be found, where foaming is the least (device should be located as far as possible from liquid inflow) or a stilling pipe or well should be used.

**WIND**

Intensive air (gas) movements in the vicinity of the ultrasonic cone is to be avoided. A strong draft of wind may "blow away" the ultrasound. Devices with lower measuring frequency (40, 20 kHz) are recommended.

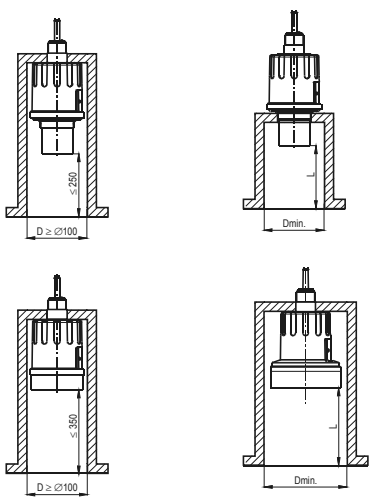


**FUMES / VAPOURS**

For closed tanks containing chemicals or other liquids, which creates fume/gases above the liquid surface especially for outdoor tanks exposed to the sun, a strong reduction of the nominal measuring range of the ultrasonic device is to be considered during device selection. Devices with lower measuring frequency (40, 20 kHz) are recommended in these cases.

**STAND-OFF**

The structure of the stand off pipe should be rigid; the inner rim where the ultrasonic beam leaves the pipe should be rounded.




| L | $D_{min}$ | | |
|---|---|---|---|
| | SP☐–39☐ | SP☐–38☐ | SP☐–37☐ |
| 150 | 50 | 60 | 60 |
| 200 | 50 | 60 | 75 |
| 250 | 65 | 65 | 90 |
| 300 | 80 | 75 | 105 |

| L | $D_{min}$ |
|---|---|
| | SP☐–34☐ |
| 90 | * |
| 200 | * |
| 350 | * |
| 500 | * |

* For values contact your distributor

## *3.2 OPEN CHANNEL FLOW MEASUREMENT*

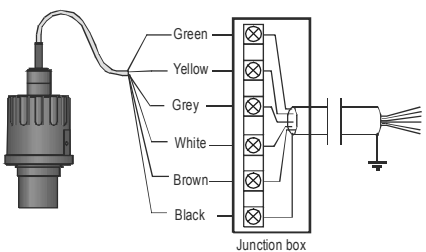
- The unit is suitable for open channel flow measurement with the constructive works listed in 5.3.8.
- For ultimate accuracy, install the sensor as close as possible above the expected maximum water level (see minimum measuring range).
- Install the unit in a place defined by the characteristics of the metering channel along the longitudinal axis of the flume or weir. In case of Parshall flumes supplied by NIVELCO the location of the sensor is marked.
- In some cases foam may develop on the surface. Make sure that the surface, opposite to the sensor, remains free of foam for proper sound reflection.
- The unit should be fixed so that it's position would not change.
- From measurement accuracy point of view the length of the channel sections preceding and following the measuring flume and their method of joining to the measuring channel section are of critical importance.
- Despite of the most careful installation, the accuracy of flow metering will be lower than that of specified for the distance measurement. The features of the flume or weir applied will determine it.
- Devices should be protected against overheating due to direct sunshine by using sunshades.

# 4. WIRING

- Make sure the terminals in the box are not under power (Use shielded cable 6 x 0.5 mm$^2$ suggested in the technical data or stronger).
- After powering the necessary programming can be performed.

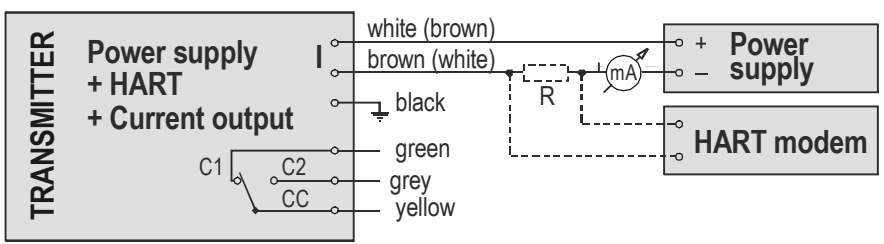
**Wire colours:**

| | | | |
|---|---|---|---|
| Green – relay **C1** output | | White – **I**, | one of the points of current loop, power supply and HART (polarity independent) |
| Yellow – relay **CC** output | | Brown – **I**, | other point of current loop, power supply and HART (polarity independent) |
| Grey – relay **C2** output | | Black – **GND**, | functional earthing and shielding point |




**Extension of the integrated cable:**

Should extension be needed the use of connection box is suggested.
The shielding of the two cables should be connected and grounded at the signal processing device.



# 5. PUTTING INTO OPERATION

## 5.1. USAGE

Subsequent to powering the correctly wired device would start to tick and after 10 - 20 s ECHO LED go on and 4 ... 20 mA signal appears on the current output. Measurement will be according to the factory setting. The factory setting is throughout apt to check proper working and to perform simple measurement tasks but features residing in the unit can only be utilised by adjusting the EasyTREK to the application by programming. For sound knowledge of the operation features and proper solving of difficult measurement applications the parts of the programming should carefully be studied.

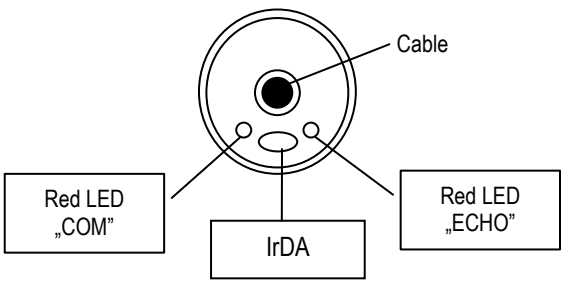
**LED indication:**

- **ECHO**-LED
  ON, if the unit detects proper echo

- **COM**-LED
  Blinking on HART communication
  Is ON in the state of remote programming

**IrDA -** Infrared communication port for
logger readout, diagnostics and software upgrade

*View of the transmitter neck from above:*




Device can be reset to factory setting. Default of EasyTREK SP-300 is the following:

- ⇒ Measurement: level (LEV)
- ⇒ Zero level assigned to the maximum distance
- ⇒ Current output proportional to the level
- ⇒ 4 mA and 0% assigned to zero level.
- ⇒ 20 mA and 100% a assigned to the maximum level (minimum distance)
- ⇒ Error indication by the current output: holds last value.
- ⇒ Damping: 60 s.

## 5.2. SAFETY REGULATION FOR THE EX APPROVED UNITS

Diameter of the cable should match the cable conduit.
The cable outside the unit should be fixed so that it should be free of loading.
The terminal box should be selected in accordance with the electrical class of the area.
Transmitter can only be powered by certified intrinsically safe current loop.
The enclosure of the transducer is plastic that can be loaded electrostatically therefore:

- Filling and emptying speed should be selected according to the medium
- Fog development of the dangerous material during filling should be avoided.
- Cleaning of the plastic enclosure is not allowed in hazardous space.

The apparatus is not suitable for flame-barrier between the space and the outside area.

## 5.3. PROGRAMMING

The HART interface of the EasyTREK provides for access to the whole parameter set and possibility of their programming. Parameter set can be reached in two different ways: by the use of the

- EView software run on the PC connected through HART modem to the loop or

- Nivelco made MultiCONT multi-channel process control unit.

Since these access methods differ in their form and handling present manual does not review them. The information is contained in the relevant descriptions and user's manuals.

### 5.3.1. MEASUREMENT CONFIGURATION

**P00: - c b a Engineering Units** FACTORY DEFAULT: 000

*Programming of this parameter will result in loading the factory default with the corresponding engineering units. Therefore all parameters should be set again!*

| a | Operation |
|---|---|
| **0** | Liquid level measurement |

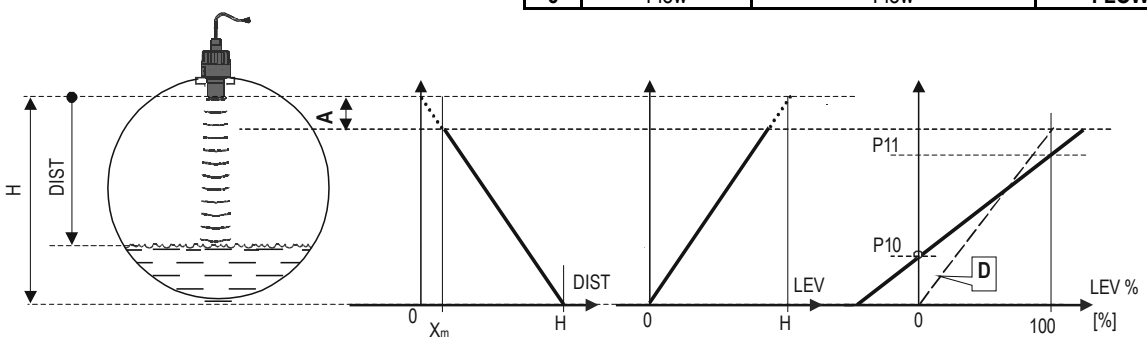
| b | Engineering units (according to "c") | |
|---|---|---|
| | **Metric** | **US** |
| **0** | m | ft |
| **1** | cm | inch |

| c | Calculation system |
|---|---|
| **0** | metric |
| **1** | US |

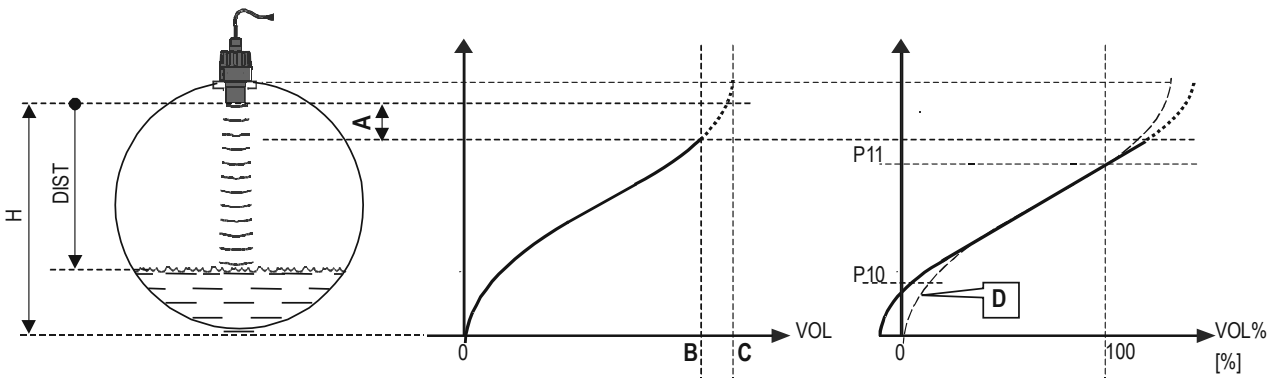
**P01: - - 1 a Measurement Mode** FACTORY DEFAULT: 11

Parameter value „a" will determine the basic measurement value that will be transmitted. Subsequently values for the relays are also relating to these quantities.

| a | Measurement mode | Transmitted value | Display symbol |
|---|---|---|---|
| **0** | Distance | Distance | **DIST** |
| **1** | Level | Level | **LEV** |
| **2** | Level % | | **LEV%** |
| **3** | Volume | Volume | **VOL** |
| **4** | Volume % | | **VOL%** |
| **5** | Flow | Flow | **FLOW** |




| Transmitted value | **DIST** | **LEV**=H-DIST | **LEV%**= $LEV * \frac{P11-P10}{H-X_m} + P10$ |
|---|---|---|---|
| Parameters to set | P00<br>P01(a) = 0<br>P05 ≥ $X_m$ | P00<br>P01(a) = 1<br>P04 = H<br>P05 ≥ $X_m$ | P00<br>P01(a) = 2<br>P04 = H<br>P05 ≥ $X_m$<br>P10 = $X_{0\%}$<br>P11 = $X_{100\%}$ |




| Transmitted value | **VOL**<br>**$f_{P40...P45}$(H-DIST)** | **VOL%**= $VOL * \frac{P11 - P10}{H - X_m} + P10$ |
|---|---|---|
| Parameters to set | P00<br>P01(a) = 3<br>P02(b)<br>P04 = H<br>P05 ≥ $X_m$<br>P40…P45 | P00<br>P01(a) = 4<br>P02(b)<br>P04 = H<br>P05 ≥ $X_m$<br>P10 = $X_{0\%}$<br>P11 = $X_{100\%}$<br>P40…P45 |

**A:** Shortest measurable distance
**B:** Volume (content) pertaining to the greatest measurable level
**C:** Whole value of the vessel
**D:** diagram valid for the default value of P10 P11

**P02: - c b a Calculation units** FACTORY DEFAULT: 000

| a | Temperature |
|---|---|
| 0 | °C |
| 1 | °F |

This table is interpreted according to **P00(c)**, **P01(a)** and **P02(c)** and is irrelevant in case of percentage measurement [ **P01(a)= 2** or **4** )]

| b | Volume | | Weight (set also P32) | | Volume flow | |
|---|---|---|---|---|---|---|
| | Metric | US | Metric | US | Metric | US |
| 0 | $m^3$ | $ft^3$ | - | lb (pound) | $m^3$/time | $ft^3$/time |
| 1 | litre | gallon | tons | tonnes | litre/time | gallon/time |

| c | Time |
|---|---|
| 0 | s |
| 1 | min |
| 2 | hour |
| 3 | day |

**Attention!**
EasyTREK is a level transmitter. Although it can be used for measuring weight, due to factors involved in doing so, accuracy may essentially be influenced.

**P04 - - - - Maximum Distance to be Measured (H)** FACTORY DEFAULT: $X_M$ as per chart

**This is the only parameter that has to be programmed for each application other than distance (however to avoid disturbing effect of possible multiple echoes it is suggested to do this in distance measurement applications too).**

The maximum distance to be measured is the greatest distance between the surface of the transducer and the farthest level to be measured. The factory programmed, greatest distances (DEFAULT values) which **can be measured** by the units are listed in the table below. For the actual application the maximum distance **to be measured** i.e. the distance between the sensor and the bottom of the tank should be entered in P04.

| EasyTREK Level transmitter for liquids | Maximum measuring distance $X_M$[m/feet] | |
|---|---|---|
| | Transducer material PP / PVDF | Transducer material PTFE |
| SP_-39 | 4/13 | 3/10 |
| SP_-38 | 6/20 | 5//16 |
| SP_-37 | 8/26 | 6/20 |
| SP_-36 | 10/33 | - |
| SP_-34 | 15/49 | - |

Since the **level** is determined by calculating the difference between the **value set in P04** and **distance (DIST) is measured** by the unit, it is essential that the correct value of (H) is set in **P04**. To obtain the best accuracy it is suggested that this distance is measured in the empty tank.

**P05: - - - - Minimum measuring distance (Dead zone - Close-end blocking)** FACTORY DEFAULT: $X_m$ as per chart

The range, beginning with the sensor's surface, within which (due to the physical restraint of the ultrasound measurement system) measurement can not be made, is called the dead zone. The EasyTREK will not accept any echo within the blocking distance set here.

Close-end blocking may be represented as the extension of the dead zone within which a possible echo will not be taken into consideration making possible to exclude disturbing objects near to the sensor.

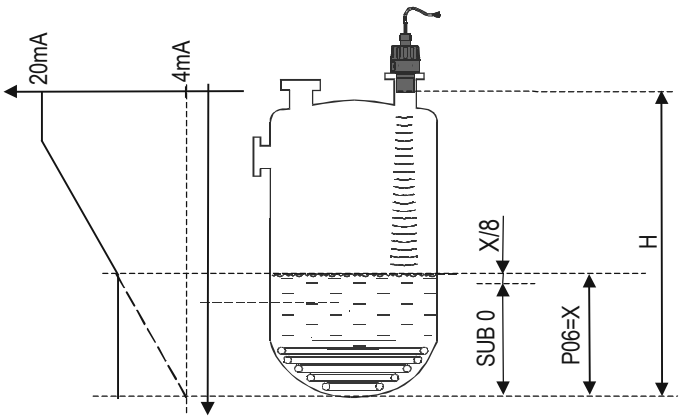
***Automatic Close-end blocking =Dead Band control* (P05 = $X_m$)**
Device with factory default will automatically *set the smallest possible dead band* depending on the conditions of the operation. This will be under optimal conditions a bit smaller in unfavourable circumstances greater than value given in the chart.

***Manual Close-end-blocking with limitation ≥ dead zone* (P05>$X_m$)**
By entering a value, higher than the factory default the close-end blocking will be either the value programmed in P05 or the actual dead zone distance (influenced by the actual conditions of the application) whichever is greater.

| EasyTREK for liquids | Minimum measuring distance $X_m$ [m/feet] | |
|---|---|---|
| | Sensor material PP / PVDF | Sensor material PTFE |
| S-39 | 0.2/0.65 | 0.2/0.65 |
| S-38 | 0.25/0.82 | 0.25/0.82 |
| S-37 | 0.35/1.2 | 0.35/1.2 |
| S-36 | 0.35/1.2 | - |
| S-34 | 0.45/1.5aggregation | - |

**P06: - - - - Far-end blocking** FACTORY DEFAULT: 0

Far-end blocking is the range below the level set in parameter **P06**. The far-end blocking can be used to avoid disturbing effect of stirrer or heaters at the bottom of the tanks. Detecting echoes in this range the unit provides special signals.




***A.) Measuring level or content***

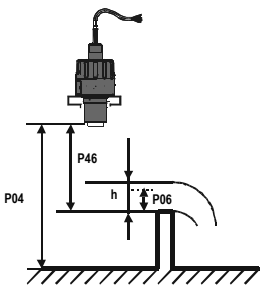
*Level sinking below*

- the value of P06 current output is according to the value of the far-end blocking and further
- below SUB 0 (7/8 of P06) the ERROR CODE 10 will be transmitted via HART

- *Level rising over value of far-end blocking:*

The calculation of level and volume will be based on the programmed tank dimensions, therefore the measured or calculated process values will not be influenced in any way, by the far end blocking value.

***B.) Open channel flow metering***




Far-end blocking will be used for those small levels below which the accurate volume flow calculation is no longer possible.

- *Level in the flume/weir sinking below the blocked out range:*
  - Output current value will be according to the value of Q = 0
  - 0 value transmitted via HART for display of „No Flow" or 0
- *Level in the flume/weir rising over the blocked out range:*
  The calculation of volume flow will be based on the programmed flume/weir data; therefore the measurement values will not be influenced in any way, by the far end blocking value.

## 5.3.2. CURRENT OUTPUT

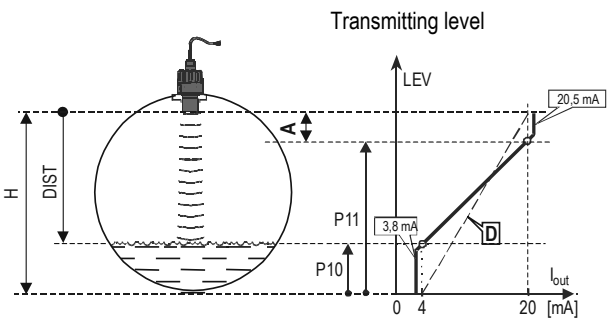
**P08: - - - - Fixed current output** FACTORY DEFAULT: 0

By this step the output current can be set for a fix value selected from between 3.8 mA and 20.5 mA. This function is not operational as per the factory default: 0. ***Attention: fixing output current will make settings in P10, P11, P12 and P19 irrelevant.***

**P10: - - - - Value (of distance, level, volume or flow) assigned to 4 mA current output** FACTORY DEFAULT: 0

**P11: - - - - Value (of distance, level, volume or flow) assigned to 20 mA current output** FACTORY DEFAULT: $X_M$ – $X_m$

Values are interpreted according to **P01(a)**. Assignment can be made so that the proportion between the change of the (measured or calculated) process value and the change of the current output be either direct or inverse. E.g. level 1 m assigned to 4mA and level 10 m assigned to 20 mA represents direct proportion and level 1 m assigned to 20 mA and level 10 m assigned to 4 mA represents the inverse proportion. Please note that in case of programming for (LEV or VOL) % measurement the min and max value has to be entered in the relevant engineering units of LEV (m, ft) or VOL ($m^3$, $ft^3$).




**A:** Smallest measurable dist.
**D**: diagram valid for default values of P10 and P11

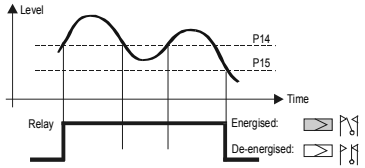
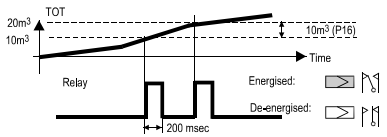
**P12: - - - a Error indication by the current output** FACTORY DEFAULT: 0

In case of error the EasyTREK will provide one of the current outputs below for the time the error prevails. (For errors see Chapter 7).

| a | Error indication by output current |
|---|---|
| **0** | HOLD (hold last value) |
| **1** | 3.6 mA |
| **2** | 22 mA |

## 5.3.3. RELAY OUTPUT

**P13: - - - a Relay function**

| a | Relay function | | Also set: |
|---|---|---|---|
| **0** | DIFFERENTIAL LEVEL CONTROL (Hysteresis control)<br>Relay is energised if the measured or calculated value exceeds the value set in P14<br>Relay is de-energised if the measured or calculated value descends under the value set in P15<br>C2 C1 |  | P14, P15<br>There is a need to set (in level min 20mm) hysteresis between P14 and P15<br>**P14 > P15** – normal operation<br>**P14 < P15** – inverted operation |
| **1** | Relay is energised in case of Echo Loss | | - |
| **2** | Relay is de-energised in case of Echo Loss | | - |
| **3** | COUNTER<br>Used for open channel flow metering.<br>A 140 msec pulse is generated every 1, 10, 100, 1.000 or 10.000 $m^3$ according to P16.<br>C2 C1 |  | P16= 0: 1$m^3$<br>P16= 1: 10 $m^3$<br>P16= 2: 100 $m^3$<br>P16= 3: 1.000 $m^3$<br>P16= 4: 10.000 $m^3$ |

In de-energised state of the device the „C1" circuit is closed.

FACTORY DEFAULT: 2

**P14: … Relay parameter – Operating value FACTORY DEFAULT: 0**

**P15: … Relay parameter – Releasing value FACTORY DEFAULT: 0**

**P16: … Relay parameter – Pulse rate FACTORY DEFAULT: 0**

FACTORY DEFAULTS: P14=0, P15=0, P16=0

## 5.3.4. DIGITAL COMMUNICATION

**P19: - - - a Short (HART) address of the unit** FACTORY DEFAULT: 2

These addresses with 0 … 15 are, in accordance with the HART standard, for distinguishing units in the same loop.

- Address: 0 current output of 4 … 20 ma operational
- Address: 1 … 15 current output is fixed to 4 mA.

## 5.3.5. MEASUREMENT OPTIMISATION

**P20: - - - a Damping** FACTORY DEFAULT: 5

This parameter can be used to reduce unwanted fluctuation of the display and output.

| a | Damping (s) | No or moderate fume / waves | Heavy or dense fume or turbulent waves |
|---|---|---|---|
| **0** | no filter | For testing only | |
| **1** | 3 | applicable | not recommended |
| **2** | 6 | recommended | applicable |
| **3** | 10 | recommended | recommended |
| **4** | 30 | recommended | recommended |
| **5** | 60 | recommended | recommended |

**P22: - - - a Dome top tank compensation** FACTORY DEFAULT: 0

This parameter can be used to reduce disturbing effect of possible multiple echoes

| a | Compensation | Remark |
|---|---|---|
| **0** | OFF | In case the EasyTREK is not mounted in the centre of the top and the top is flat. |
| **1** | ON | In case the EasyTREK is mounted in the centre of a tank with dome-shaped top |

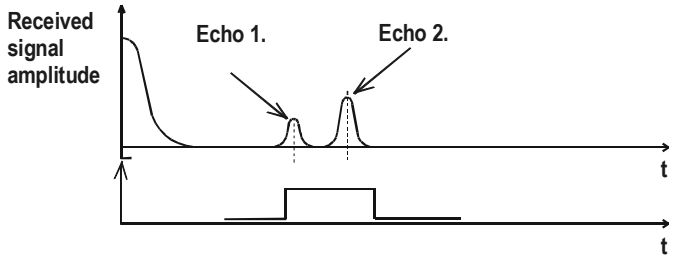
**P24: - - - a Target tracking speed** FACTORY DEFAULT: 0

In this parameter evaluation can be speed up at the expense of the accuracy.

| a | Tracking speed | Remark |
|---|---|---|
| **0** | Standard | For most applications |
| **1** | Fast | For fast changing level |
| **2** | Special | Only for special applications (measuring range is reduced to 50% of the nominal value)<br>The measuring window is inactive and the EasyTREK will respond practically instantly to any target. |

**P25: - - - a Selection of Echo within the measuring window** FACTORY DEFAULT: 0

A so-called measuring window is formed around the echo signal. The position of this measuring window determines the flight time for calculation of the distance to the target. (the picture below can be seen on the test oscilloscope)




Some applications involve multiple (target + disturbing) echoes even within the measuring window. Basic echo selection will be done by the Quest + software automatically. This parameter influences the echo selection only within the measuring window.

| a | Echo in the window to be selected | Remark |
|---|---|---|
| **0** | With the highest amplitude | Most frequently used |
| **1** | First one | For liquids applications with multiple echoes within the Measuring Window |

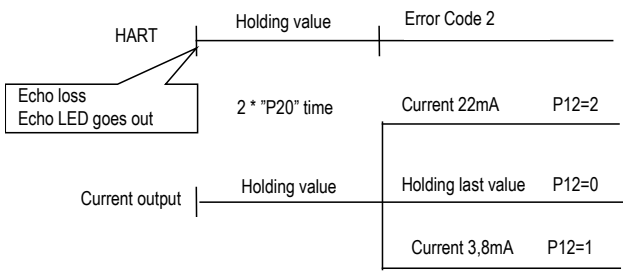
**P26: - - - - Level elevation rate (filling speed) (m/h or ft/h)** FACTORY DEFAULT: 2000

**P27: - - - - Level descent rate (emptying speed) ) (m/h or ft/h)** FACTORY DEFAULT: 2000

These parameters provide additional protection against echo loss in applications involving very heavy fuming. Correct setting increases reliability of the measurement during filling and emptying. The parameters must not be smaller than the fastest possible filling/emptying rate of the actual technology.

***Attention!*** *Level changing rate is rather different near to the conical or spherical bottom of such a vessel.*

**P28 - - - a Echo loss indication** FACTORY DEFAULT: 0

| a | Echo loss indication | Remark |
|---|---|---|
| **0** | Delayed indication | During short echo-loss (for the period of twice the time set in **P20**) analogue output will hold last value. After this period the current value according to the setting in **P12** and via HART ERROR CODE 2 will be transmitted.   |
| **1** | No indication | For the time of echo-loss, analogue output will hold last value. |
| **2** | Filling simulation | Loosing echo during the filling process, transmitted value will increase according to the filling speed set in **P26** |
| **3** | Immediate indication | Loosing echo the current value (according to the setting in **P12**) and the **ERROR CODE 2** (via HART) will immediately be transmitted. |
| **4** | Empty tank indication | Echo-loss may occur in completely empty tanks with a spherical bottom due to deflection of the ultrasonic beam, or in case of silos with an open outlet. In such cases it may be useful to indicate empty tank instead of echo loss. |

**P29 - - - - Blocking out of disturbing object** FACTORY DEFAULT: 0

One fixed object in the tank, disturbing the measurement, can be blocked out. By the use of the Echo Map (**P70**) the precise distance of disturbing object can be read out. This value should be entered in this parameter.

**P31: - - - - Sound velocity at 20°C (m/s or ft/s depending on P00(c)** FACTORY DEFAULT:: 343,8 (m/s), 1128 (ft/s)

This parameter should be used if the sound velocity in the gases above the measured surface differs largely from that of in the air. This is recommended for applications where the gas is more or less homogeneous. If it is not, the accuracy of the measurement can be improved using 32-point linearisation (**P48**, **P49**).

*For sound velocities in various gases see section "Sound Velocities".*

**P32: - - - - Specific gravity** FACTORY DEFAULT: 0

Entering a value (other than "0") of specific gravity in this parameter, the weight will be displayed instead of VOL.

Engineering unit should be [kg/dm$^3$] or [lb/ft$^3$] depending on **P00** (c)

## 5.3.6. DATA LOGGER

The logger of the device can store 12288 events. The registry is in a non-volatile (FLASH) memory, so the registry will retain its contents even in case of a power failure. The on-board clock of the device is protected against short power-outs, and keeps working for at least 15 days after the device is switched off. The battery protecting the clock needs at least two hours to be recharged.

The logger operates in two basic ways.

**Linear logging,** whereby an entry is logged after every time period configured in P35.

**Event-controlled logging**, whereby an entry is logged after an internal event occurs or condition is fulfilled.

The capacity of the registry allows the following logging times in linear logging mode:

| P35 [min] | Time of logging | Note |
|---|---|---|
| **0** | 3..5 hrs. | depends on device type and measurement cycle time |
| **1** | 7..8 days | |
| **5** | 40 days | |
| **10** | 80 days | |
| **60** | 500 days (16 months) | |

Content of a log:

- entry time (with an accuracy of 1 minute)
- primary measured value (P01)
- level and distance values
- sensor temperature
- output current
- error and status variables

The registry can be erased in parameter P79. See: P79.

**P34: - cba Logging mode**

| a | Operating mode | Parameters to be programmed |
|---|---|---|
| **0** | No logging | |
| **1** | Linear logging | **P35** – interval (minute) |
| **2** | Event-controlled logging when the primary value changes | **P35** – absolute value of variation |
| **3** | Event-controlled logging when the primary value changes | **P35** – variation in % |
| **4** | Event-controlled logging when the primary value gets out of range | **P35, P36** – absolute values of range limits |

| b | Logging of errors and warnings (a>0) |
|---|---|
| **0** | No logging |
| **1** | Logging of all errors and warnings |
| **2** | Logging of errors only |
| **3** | Logging of **NoEcho** only |

| c | Logging of changes in status (a>0) |
|---|---|
| **0** | No logging |
| **1** | Logging of change in status |

FACTORY SETTING: 000 (no logging)

Errors that may generate an entry if P34/b<>0: NOECHO, ERR12, ERR13, ERR14, ERR15, ERR16, SUB0, ERR4, ERR5, PT ERR (temperature measurement error).

## P35-36: Log value 1 and log value 2

| P34a | Operating mode | Function of P35 and P36 |
|---|---|---|
| **0** | No logging | |
| **1** | Linear logging | **P35 = 0** One entry after every measurement cycle.<br>**P35 <> 0** Logging interval (minutes)<br>**P36** Value is indifferent |
| **2** | Event-controlled logging when the primary value changes | **P35** Absolute value of the change in the primary measured value (according to P01a)<br>P35 is defined as the dimension of the primary measured unit.<br>Log entry occurs if the value of the primary measured value deviates from the measured value of the previous cycle in any direction by the amount specified in P35.<br>**P36** Value is indifferent |
| **3** | Event-controlled logging when the primary value changes | **P35** Relative (%) value of primary measured value (according to P01a) variation.<br>P35 is a relative quantity so its dimension is percent.<br>Log entry occurs if the value of the primary measured value deviates from the measured value of the previous cycle in any direction by the amount specified in P35.<br>**P36** Value is indifferent |
| **4** | Event-controlled logging when the primary value gets out of range in any direction | **P35, P36** Absolute values of the limits of the range of the primary measured values (according to P01a). P35 and P36 have the same dimension as the primary measured value.<br>Log entry occurs if the value of the primary measured value steps over the limit given in P35 and P36, in any direction.<br>To monitor only one limit value, set it in P35 and let P36 be 0. |

FACTORY SETTING: P35 = 0, P36 = 0

**P37: yyyy Real-time clock, year**

Year setting for date of the on-board clock. (2005)

**P38: mmdd Real-time clock, month and day**

Month (mm) and day (dd) setting for date of the on-board clock.

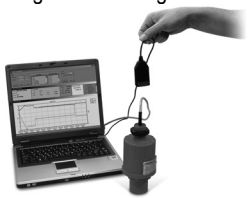
**P39: HHMM Real-time clock, hour and minute**

Hour (HH) and minute (MM) setting of the on-board clock.

### *5.3.6.1 READING DATA OUT FROM THE LOGGER*

Reading the logger is only possible with digital communication. For this purpose the built-in IrDA communication port can be used. The content of the log can also be read out via HART communication, but because of the slow speed of HART, it takes several hours. To access the data content use of NIVELCO's DataScope program is recommended. During this high-speed communication the device sets the output current to 22 mA. There is no measurement while retrieving data from the register, so measurement values are not updated.

Connecting to a PC using an IrDA adapter:



The IrDA adapter and the IrDA port of the device must be placed whithin a 5…50 cm distance and facing each other!

| | | |
|---|---|---|
| Recommended IrDA adapters: | - RedSnake: | IL-200 |
| ***(only IrDA to RS232 adapters can be used)**** | - ActiSys: | ACT-IR200S |
| | | ACT-IR220L+ |
| | | ACT-IR220LR |
| | - Esis: | M8421 |

** Recommended RS232-USB adapters for using the USB port: STLab: USB-RS232*
*MOXA: NPort-U1110, UPort 1110*

After connecting the adapters start DataScope program. The program and the User's Manual can be found on the EviewLight CD.

## 5.3.7. VOLUME (CONTENT) MEASUREMENT

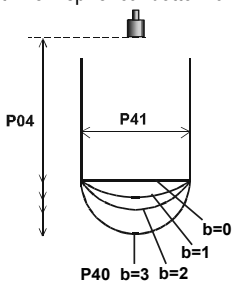
**P40: - - ba Tank shape** FACTORY DEFAULT: 00

| ba | Tank shape | Also to be set |
|---|---|---|
| **b0** | Standing cylindrical tank shape (value of "b" as below) | **P40** (b), **P41** |
| **01** | Standing cylindrical tank with conical bottom | **P41**, **P43**, **P44** |
| **02** | Standing rectangular tank (with chute) | **P41**, **P42**, **P43**, **P44**, **P45** |
| **b3** | Lying cylindrical tank shape (value of "b" as bellow) | **P40** (b), **P41**, **P42** |
| **04** | Spherical tank | **P41** |

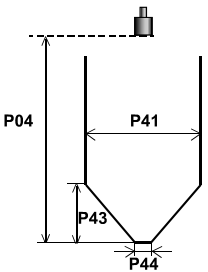
**Attention!**
**The value „a" determining the shape of the tank should be set first.**

**P41-45: - - - - Tank dimensions** FACTORY DEFAULT: 0

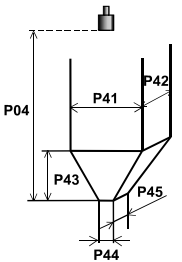
Standing cylindrical tank with hemispherical bottom a=0




Standing cylindrical tank with conical bottom a=1 b=0

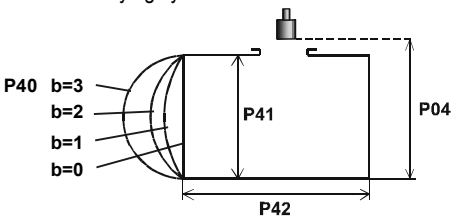



Standing rectangular tank with or without chute a=2 b=1

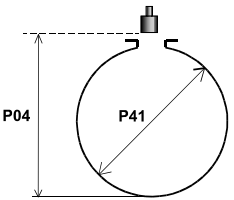



Plain bottom **P43**, **P44** and **P45** = 0

Lying cylindrical tank a = 3




Spherical tank a = 4, b = 0



## *5.3.8. OPEN CHANNEL FLOW MEASUREMENT*

**P40: - - b a Devices, formula, data** FACTORY DEFAULT: 00

| ba | Devices, formula, data | | | | | | Also to be set |
|---|---|---|---|---|---|---|---|
| | | Type | Formula | Qmin [l/s] | Qmax [l/s] | "P" [cm] | |
| **00** | **Nivelco Parshall channels** | GPA-1P1 | Q [l/s]= $60.87*h^{1.552}$ | 0.26 | 5.38 | 30 | **P46** |
| **01** | | GPA-1P2 | Q [l/s]= $119.7*h^{1.553}$ | 0.52 | 13.3 | 34 | **P46** |
| **02** | | GPA-1P3 | Q [l/s]= $178.4*h^{1.555}$ | 0.78 | 49 | 39 | **P46** |
| **03** | | GPA-1P4 | Q [l/s]= $353.9*h^{1.558}$ | 1.52 | 164 | 53 | **P46** |
| **04** | | GPA-1P5 | Q [l/s]= $521.4*h^{1.558}$ | 2.25 | 360 | 75 | **P46** |
| **05** | | GPA-1P6 | Q [l/s]= $674.6*h^{1.556}$ | 2.91 | 570 | 120 | **P46** |
| **06** | | GPA-1P7 | Q [l/s]= $1014.9*h^{1.556}$ | 4.4 | 890 | 130 | **P46** |
| **07** | | GPA-1P8 | Q [l/s]= $1368*h^{1.5638}$ | 5.8 | 1208 | 135 | **P46** |
| **08** | | GPA-1P9 | Q [l/s]= $2080.5*h^{1.5689}$ | 8.7 | 1850 | 150 | **P46** |
| **09** | General PARSHALL flume | | | | | | **P46**, **P42** |
| **10** | PALMER-BOWLUS (D/2) | | | | | | **P46**, **P41** |
| **11** | PALMER-BOWLUS (D/3) | | | | | | **P46**, **P41** |
| **12** | PALMER-BOWLUS (Rectangular) | | | | | | **P46**, **P41**, **P42** |
| **13** | Khafagi Venturi | | | | | | **P46**, **P42** |
| **14** | Bottom-step weir | | | | | | **P46**, **P42** |
| **15** | Suppressed rectangular or BAZIN weir | | | | | | **P46**, **P41**, **P42** |
| **16** | Trapezoidal weir | | | | | | **P46**, **P41**, **P42** |
| **17** | Special trapezoidal (4:1) weir | | | | | | **P46**, **P42** |
| **18** | V-notch weir | | | | | | **P46**, **P42** |
| **19** | THOMSON (90°-notch) weir | | | | | | **P46** |
| **20** | Circular weir | | | | | | **P46**, **P41** |
| **21** | General flow formula: Q[l/s]= 1000***P41***$*h^{P42}$, h [m] | | | | | | **P46**, **P41**, **P42** |

**P41-45: Flume/weir dimensions** FACTORY DEFAULT: 0

**P40=00**

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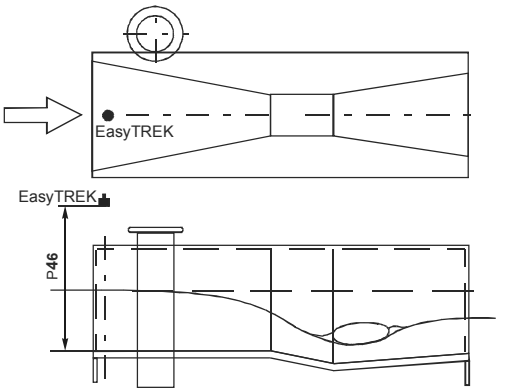
.

. **Nivelco Parshall flumes (GPA1P1 … GPA-1P9)**

For further details see the Manual of the Parshall flume




**P40=09**

**General Parshall flume**

0.305 < **P42**(width) <2.44

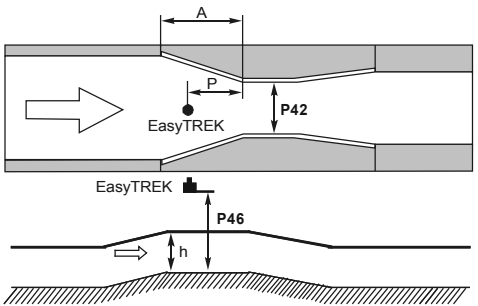
$$Q[l/s] = 372 \cdot \mathbf{P42} \cdot (h/0{,}305)^{1{,}569\,\mathbf{P42}^{0{,}026}}$$

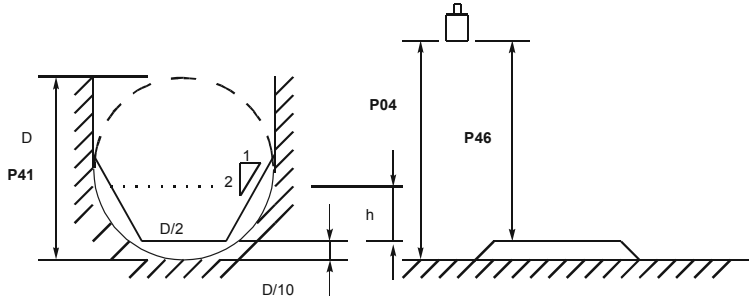
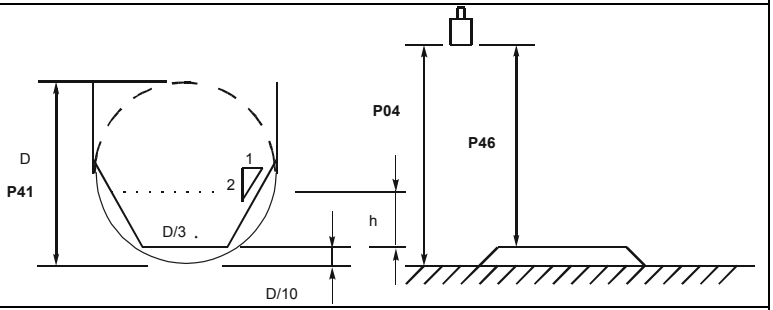
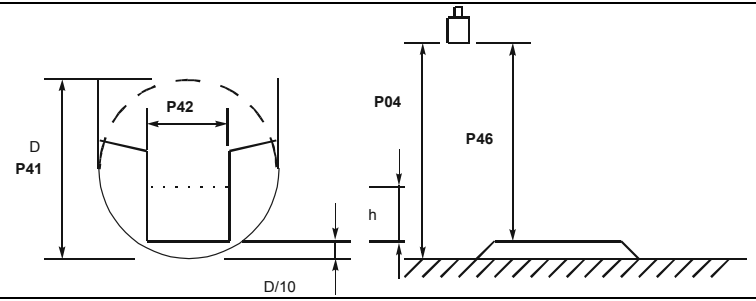
2.5 < **P42**

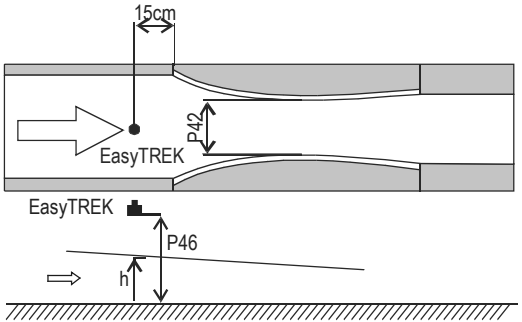
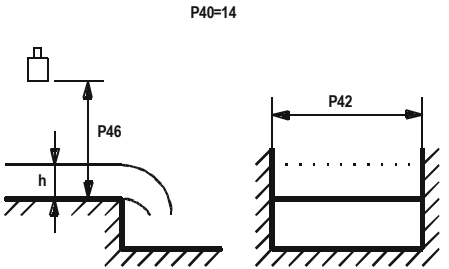
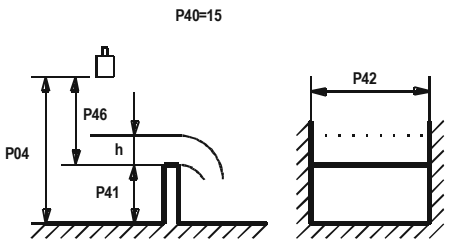
$Q[l/s] = K * \mathbf{P42} * h^{1.6}$

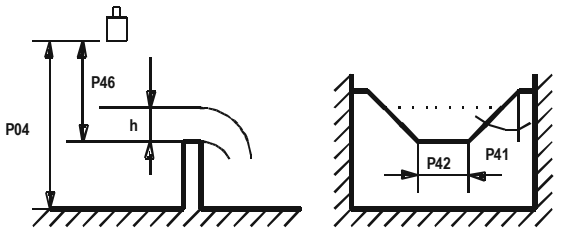
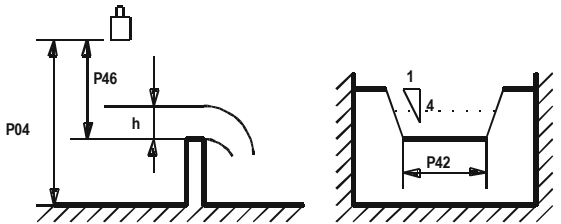
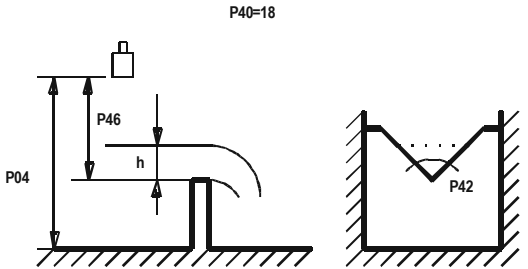
P= 2/3*A

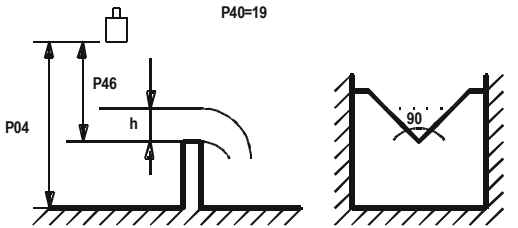
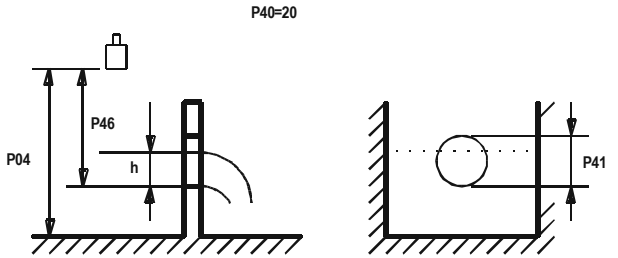
| P42 [m] | K |
|---|---|
| 3.05 | 2.450 |
| 4.57 | 2.400 |
| 6.10 | 2.370 |
| 7.62 | 2.350 |
| 9.14 | 2.340 |
| 15.24 | 2.320 |



| | | |
|---|---|---|
| **P40= 10** | **Palmer-Bowlus (D/2) flume**<br>Q[$m^3/s$]= f(h1/**P41**)∗**P41**$^{2.5}$, where h1[m]= h+(**P41**/10)<br>**P41** [m] |  |
| **P40= 11** | **Palmer-Bowlus (D/3) flume**<br>Q[$m^3/s$]= f(h1/**P41**)∗**P41**$^{2.5}$, where h1[m]= h+(**P41**/10)<br>**P41** [m] |  |
| **P40= 12** | **Palmer-Bowlus (rectangular) flume**<br>Q[$m^3/s$]= C∗**P42**∗h$^{1.5}$, where C= f(**P41**/**P42**)<br>**P41** [m], **P42** [m] |  |

| | | |
|---|---|---|
| **P40= 13** | **Khafagi Venturi flume**<br>Q [m³/s] = 1.744 ·**P42** · $h^{1.5}$ + 0.091 · $h^{2.5}$<br>**P42** [m]<br>h [m] |  |
| **P40= 14** | **Bottom step weir**<br>0.0005 < Q [m³/s] < 1<br>0.3 < **P42** [m] < 15<br>0.1 < h [m] < 10<br>Q [m³/s]= 5.073 · **P42** · $h^{1.5}$<br>Accuracy: ± 10% |  |
| **P40= 15** | **Suppressed rectangular or BAZIN weir**<br>0.001 < Q [m³/s] < 5<br>0.15 < **P41** [m] < 0.8<br>0.15 < **P42** [m] < 3<br>0.015 < h [m] < 0.8<br>Q [m³/s] =1.77738(1+0.1378h/**P41**) · **P42** · $(h+0.0012)^{1.5}$<br>Accuracy: ±1% |  |

| | | |
|---|---|---|
| **P40= 16** | **Trapezoidal weir**<br>0.0032 < Q [$m^3/s$] < 82<br>20 < **P41**[°] < 100<br>0.5 < **P42** [m] < 15<br>0.1 < h [m] < 2<br>Q [$m^3/s$] = 1.772 · **P42** · $h^{1.5}$ + 1.320 ·tg(**P41**/2) · $h^{2.47}$<br>Accuracy: ±5% | P40=16<br>  |
| **P40= 17** | **Special trapezoidal (4:1) weir**<br>0.0018 < Q [$m^3/s$] < 50<br>0.3 < **P42** [m] < 10<br>0.1 < h [m] < 2<br>Q [$m^3/s$] = 1.866 · **P42** · $h^{1.5}$<br>Accuracy: ±3% | P40=17<br>  |
| **P40= 18** | **V-notch weir**<br>0.0002 < Q [$m^3/s$] < 1<br>20 < **P42**[°] < 100<br>0.05 < h [m] < 1<br>Q[$m^3/s$] = 1.320 · tg(**P42**/2) · $h^{2.47}$<br>Accuracy: ±3% | P40=18<br>  |

| | | |
|---|---|---|
| **P40= 19** | **THOMSON (90°-notch) weir**<br>0.0002 < Q [$m^3/s$] < 1<br>0.05 < h [m] < 1<br>Q[$m^3/s$] = 1.320 · $h^{2.47}$<br>Accuracy: ±3% |  |
| **P40= 20** | **Circular weir**<br>0.0003 < Q [$m^3/s$] < 25<br>0.02 < h [m] < 2<br>Q[$m^3/s$] = m*b · $D^{2.5}$. where b = f (h/D)<br>m= 0.555+0.041 · h/**P41**+(**P41**/(0.11 · h))<br>Accuracy: ±5% |  |

**P46: - - - - Distance at Q=0** FACTORY DEFAULT: 0

Distance between sensor surface and the level at which flow starts has to be entered in this parameter.

## 5.3.9. 32-POINT LINEARISATION

**P47: - - - a Linearisation** FACTORY DEFAULT: 0

Linearisation is the method of assigning requested (calibrated or calculated) level, volume or flow to values measured by the transmitter.

It can be used for instance if the sound velocity is not known (LEVEL⇒LEVEL) or in the case of tank with other shape than under 6.4 or open channel other than under 6.5 (LEVEL ⇒ VOLUME or LEVEL ⇒ FLOW).

| a | Linearisation |
|---|---|
| 0 | OFF (FACTORY DEFAULT) |
| 1 | ON |

Conditions of correct programming of the data pairs

The table must always start with: L(1)= 0 and r(1)= value (assigned to 0 level)

The table must be ended either with the 32nd data pair i.e. j=32 or if the linearisation table contains less than 32 data-pairs j<32, it must be ended with a level value "0" e.g. **L**(j<32)= 0.

The EchoTREK will ignore data after recognising level value "0" with serial number other than "1".

**If the above conditions are not met, error codes will be displayed (see chapter: Error Codes).**

| i | **L** (Left column)<br>Level values measured | **r** (Right column)<br>Value assigned to transmit |
|---|---|---|
| 1 | 0 | r(1) |
| 2 | L(2) | r(2) |
| | L(i) | r(i) |
| nn | L(nn) | r(nn) |
| nn+1 | 0 | |
| 32 | | |

**P48: Number of linearisation data pairs**

Number of linearisation data pairs entered in the table.

## *5.3.10. INFORMATIONAL PARAMETERS (READ OUT PARAMETERS)*

**P60: - - - - Overall operating hours of the unit (h)**

**P61: - - - - Time elapsed after last switch-on (h)**

**P62: - - - - Operating hours of the relay (h)**

**P63: - - - - Number of switching cycles of the relay**

**P64: - - - - Actual temperature of the transducer (°C/°F)**

Broken loop of the thermometer will be indicated by display of the Pt Error message initiated by a signal sent via HART. In this case the transmitter will perform temperature correction corresponding to 20ºC.

**P65: - - - - Maximum temperature of the transducer (°C/°F)**

**P66: - - - - Minimum temperature of the transducer (°C/°F)**

**P70: - - - - Number of Echoes / Echo Map**

Amplitude and position of the echoes can also be read out.

**P71: - - - - Distance of the of Measuring Window**

**P72 - - - - Amplitude of the selected echo [dB] <0**

**P73: Position of the selected echo (time) :(ms)[ms]**

**P74: Signal To Noise Ratio**

| Ratio | Measurement conditions |
|---|---|
| Over 70 | Excellent |
| Between 70 and 30 | Good |
| Under 30 | Unreliable |

**P75: - - - - Blocking Distance**

The actual close-end blocking distance will be displayed (provided automatic blocking was selected in **P05)**.

## 5.3.11. ADDITIONAL PARAMETERS OF THE FLOW METERING

**P76: - - - - Head of flow (LEV) (Read only parameter)**

The Headwater value can be checked here. This is the "h" value in the formula for flow calculation.

**P77: - - - - TOT1 volume flow totalised (resettable)**

**P78: - - - - TOT2 volume flow totalised (non-resettable)**

## 5.3.12. SUPPLEMENTARY PARAMETER OF THE LOGGER

**P79: Free space of logger in percent**

If the value is 0, the registry has overflown and every new entry will overwrite the oldest one.

### Clearing the logger

1). Enter parameter **P79**.
2). Press ⓔ + ⓓ keys.
3). The display flashes „Lo-Clr" message.
4). Pressing Ⓔ will clear the logger.

## 5.3.13. OTHER PARAMETERS

**P96: - - - - Software code 1 (Read only parameter)**

**P97: - - - - Software code 2 (Read only parameter)**

**P98: - - - - Hardware code (Read only parameter)**

**P99: dcba Access lock by secret code**

The purpose of this feature is to provide protection against accidental programming or intentional reprogramming of parameters by a person not entitled to do so. The secret code can be any value other than **0000**. Setting a secret code will automatically be activated when the EasyTREK is returned to the Measurement Mode. In order to program locked device the secret code should be entered first in **P99.** Thus for entering a new code or erasing the old one the knowledge of the previous code is necessary.

# 6. MAINTENANCE AND REPAIR

EasyTREK SP units do not require maintenance on a regular basis.
The need for cleaning of the sensor head may occur. Cleaning should be performed by utmost care where scraping or denting of the transducer have to be avoided.
Repair under or after the guarantee period should only be carried out by Nivelco. Devices for repair should only be returned duly cleaned and disinfected.

## *6.1 SOFTWARE UPGRADE*

Based on the observations & needs of our customers NIVELCO constantly improves and revises the operating software of the device. The software can be upgraded with the help of the IrDA communication port of the device. For more information about software updates please contact Nivelco.

# 7. ERROR CODES

| Error Code | Error description | Causes and solutions |
|---|---|---|
| **1** | Memory error | Contact local agent |
| **No Echo** | Echo loss | See Action 5 and 6 |
| **3** | Hardware error | Contact local agent |
| **4** | Display overflow | Check settings |
| **5** | Sensor error or improper installation/mounting, level in the dead band | Verify sensor for correct operation and check for correct mounting according to the User's Manual |
| **6** | The measurement is at the reliability threshold | Better location should be found. |
| **7** | No signal received within the measuring range specified in P04 and P05 | Check programming, also look for installation mistake |
| **12** | Linearisation table error: both L(1) and L(2) are zero (no valid data-pairs) | See "Linearisation" Section |
| **13** | Linearisation table error: same L(i) data is given twice in the table | See "Linearisation" Section |
| **14** | Linearisation table error: the r(i) values are not monotone increasing | See "Linearisation" Section" |
| **15** | Linearisation table error: measured Level is higher than the last Volume or Flow data-pair | See "Linearisation" Section" |
| **16** | The check sum of the program is wrong | Contact local agent |
| **17** | Parameter consistency failure | Check programming |
| **18** | Hardware failure | Contact local agent |

# 8. PARAMETER TABLE

| Par. | Page | Description | Value d c b a |
|---|---|---|---|
| **P00** | 14 | Application/Engineering Units | |
| **P01** | 15 | Measurement Mode | |
| **P02** | 17 | Calculation units | |
| **P03** | | - | |
| **P04** | 17 | Maximum Measuring Distance | |
| **P05** | 18 | Minimum Measuring Distance | |
| **P06** | 19 | Far End Blocking | |
| **P07** | | – | |
| **P08** | 20 | Fixed current output | |
| **P09** | | – | |
| **P10** | 20 | Transmitted value assigned to „4 mA" | |
| **P11** | 20 | Transmitted value assigned to „20 mA" | |
| **P12** | 20 | "Error" indication by the current output | |
| **P13** | 21 | Relay function | |
| **P14** | 21 | Relay parameter – Operating value | |
| **P15** | 21 | Relay parameter – Releasing value | |
| **P16** | 21 | Relay parameter – Pulse rate | |
| **P17** | | – | |
| **P18** | | – | |
| **P19** | 22 | Short address of the unit | |
| **P20** | 22 | Damping | |
| **P21** | | – | |
| **P22** | 22 | Dome top tank compensation | |
| **P23** | | – | |
| **P24** | 22 | Target tracking speed | |
| **P25** | 23 | Selection of Echo in the measuring window | |
| **P26** | 23 | Level elevation rate | |
| **P27** | 23 | Level descent rate | |

| Par. | Page | Description | Value d c b a |
|---|---|---|---|
| **P28** | 24 | Echo loss indication | |
| **P29** | 25 | Blocking out a disturbing object | |
| **P30** | | – | |
| **P31** | 25 | Sound velocity values in different gases | |
| **P32** | 25 | Specific gravity | |
| **P33** | | – | |
| **P34** | 27 | Logging mode | |
| **P35** | 28 | Log value 1 and log value 2 | |
| **P36** | 28 | Log value 1 and log value 2 | |
| **P37** | 29 | Real-time clock, year | |
| **P38** | 29 | Real-time clock, month and day | |
| **P39** | 29 | Real-time clock, hour and minute | |
| **P40** | 30 | Selection of tank shape/ open channel | |
| **P41** | 30 | Dimensions of tank / Open Channel | |
| **P42** | 30 | Dimensions of tank / Open Channel | |
| **P43** | 30 | Dimensions of tank / Open Channel | |
| **P44** | 30 | Dimensions of tank / Open Channel | |
| **P45** | 30 | Dimensions of tank / Open Channel | |
| **P46** | 36 | Level pertaining to flow Q= 0 | |
| **P47** | 37 | Linearisation | |
| **P48** | 37 | Linearisation table | |
| **P49** | | – | |
| **P50** | | – | |
| **P51** | | – | |
| **P52** | | – | |
| **P53** | | – | |
| **P54** | | – | |
| **P55** | | – | |

| Par. | Page | Description | Value d | c | b | a |
|---|---|---|---|---|---|---|
| **P56** | | – | | | | |
| **P57** | | – | | | | |
| **P58** | | – | | | | |
| **P59** | | – | | | | |
| **P60** | 38 | Overall operating hours of the unit | | | | |
| **P61** | 38 | Time elapsed after last switch-on | | | | |
| **P62** | 38 | Operating hours of the relay | | | | |
| **P63** | 38 | Number of switching cycles of the relay | | | | |
| **P64** | 38 | Actual temperature of the transducer | | | | |
| **P65** | 38 | Maximum temperature of the transducer | | | | |
| **P66** | 38 | Minimum temperature of the transducer | | | | |
| **P67** | | – | | | | |
| **P68** | | – | | | | |
| **P69** | | – | | | | |
| **P70** | 38 | Echo Map | | | | |
| **P71** | 38 | Position of the measuring window | | | | |
| **P72** | 38 | Amplitude of the selected echo | | | | |
| **P73** | 38 | Position of the selected echo | | | | |
| **P74** | 38 | Signal / noise ratio | | | | |
| **P75** | 38 | Blocking distance value | | | | |
| **P76** | 39 | Water head of the flow | | | | |
| **P77** | 39 | TOT1 volume flow totalised | | | | |
| **P78** | 39 | TOT2 volume flow totalised | | | | |
| **P79** | 39 | Free space of the logger in percent | | | | |
| **P80** | | – | | | | |
| **P81** | | – | | | | |
| **P82** | | – | | | | |
| **P83** | | – | | | | |
| **P84** | | – | | | | |
| **P85** | | – | | | | |
| **P86** | | – | | | | |
| **P87** | | – | | | | |
| **P88** | | – | | | | |
| **P89** | | – | | | | |
| **P90** | | – | | | | |
| **P91** | | – | | | | |
| **P92** | | – | | | | |
| **P93** | | – | | | | |
| **P94** | | – | | | | |
| **P95** | | – | | | | |
| **P96** | 39 | Software code 1 | | | | |
| **P97** | 39 | Software code 2 | | | | |
| **P98** | 39 | Hardware code | | | | |
| **P99** | 39 | Access lock by secret code | | | | |

# 9. SOUND VELOCITY VALUES IN DIFFERENT GASES

The following table contains the sound velocity values of various gases measured at **20°C**.

| Gases | Formula | Sound Velocity (m/s) |
|---|---|---|
| Acetaldehyde | $C_2H_4O$ | 252.8 |
| Acetylene | $C_2H_2$ | 340.8 |
| Ammonia | $NH_3$ | 429.9 |
| Argon | Ar | 319.1 |
| Benzene | $C_6H_6$ | 183.4 |
| Carbon dioxide | $CO_2$ | 268.3 |
| Carbon monoxide | CO | 349.2 |
| Carbon tetrachloride | $CCl_4$ | 150.2 |
| Chlorine | $Cl_2$ | 212.7 |
| Dimethyl ether | $CH_3OCH_3$ | 213.4 |
| Ethane | $C_2H_6$ | 327.4 |
| Sulphur hexafluoride | $SF_6$ | 137.8 |

| Gases | Formula | Sound Velocity (m/s) |
|---|---|---|
| Ethanol | $C_2H_3OH$ | 267.3 |
| Ethylene | $C_2H_4$ | 329.4 |
| Helium | He | 994.5 |
| Hydrogen sulphide | $H_2S$ | 321.1 |
| Methane | $CH_4$ | 445.5 |
| Methanol | $CH_3OH$ | 347 |
| Neon | Ne | 449.6 |
| Nitrogen | $N_2$ | 349.1 |
| Nitrogen monoxide | NO | 346 |
| Oxygen | $O_2$ | 328.6 |
| Propane | $C_3H_8$ | 246.5 |

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Nivelco reserves the right to change technical specifications without notice.